Analysis of Customer's Expectations and Satisfaction in Zanjan Municipality Using Fuzzy Multi-Criteria Decision Making (FMCDM) Approach

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Abstract

Customer satisfaction is the most important step in the process of identifying customer expectations. Identifying customer expectations without any reference to or obtaining personal view of the subject is impossible. In order to identify customer expectations, service suppliers used statistical techniques and surveyed their customers. According to the studies, there is no appropriate framework for expectation model to prioritize regions of organizations and make the favorable selection according to the organization's policies and strategies. In this research, a combination of fuzzy multiple-criteria decision-making is used for the optimal selection. The research method used in this study is of descriptive and applied types, and field method is used to collect data. For Identifying customer expectations, data have been collected from study population (customers of Zanjan municipality), showing 303 people through random sampling method. To rank the dimensions of customer's expectations and make optimal selections for municipality zones, data have been collected from study population (engineer contractor of the municipality), showing 30 people. Questionnaire and interview were used as instruments of data collection, which proved valid. The Expert Choice, Web-based TOPSIS, SPSS, and Excel software products were used for calculations. It is interesting to observe that the choices of the best municipality zone solely depend on the criterion with the maximum priority value. Based on calculations on the stages of the proposed model, "municipality Zone 2" was selected as the optimal region and had the highest rating in response to customer expectations. Results show that the proposed model has a systematic fit with the defined procedures and known inputs.
Keywords: Customer expectations, Multi criteria decision making, Fuzzy analysis network process (FANP), Fuzzy TOPSIS method, Fuzzy ELECTRE method.

1. Introduction

Many different theories and methods of performance have been applied in various organizations over many years for the sake of conducting an evaluation. These approaches include Analytic Hierarchical Process (AHP), Data Envelopment Analysis (DEA), Decision Making Trial and Evaluation laboratory (DEMATEL), Fuzzy Analytic Hierarchical Process (FAHP), Fuzzy Analytic Network Process (FANP), etc. Each method has its own concept, purpose, advantage, and disadvantage. Choice preference for assessing performance depends upon the situation and type of the organizations. However, all successful organizations have some common features, including a positive action and effective performance evaluation.

Achieving customer satisfaction is the main goal of many companies, especially service providers and many managers strive to achieve customer satisfaction. Since customer expectations and satisfaction are dynamic parameters which change over time, we need to regularly assess clients' expectations. By obtaining an understanding of customer requirements, we can determine the necessary steps to meet the clients' needs. Most organizations throughout the country assess customer satisfaction and build strong customer relationships, and many studies have been conducted with the same topic, with different aspects of determining the level of customer satisfaction. Although the position of the municipality in front of its customers is exclusive and one-sided, but according to customer-oriented culture, which leads to changes of the culture and values within the organization, the staff and management within the company turned it (because the customer-centered organization-wide communication networks with rewards are valuable to the municipality and its employees). Also, it has the financial rewards (money, bonuses, etc.) as well has a spiritual dimension (honor, reputation in the country, etc.) both at the individual and organizational levels. So, in this situation, identifying and satisfying

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generally expressed in linguistic terms. Some of the studies in this field are as follows. Feizizadeh et al. suggested integrating the Monte Carlo Simulation and Global Sensitivity Analysis with the conventional AHP for analyzing the uncertainty and sensitivity of landslide susceptibility as a function of weights (Feizizadeh et al, 2014). Chakrabortya and Chatterjeeb (2013) solved five material selection problems using three common MCDM techniques (VIKOR, TOPSIS, ELECTRE) to demonstrate the effect of number of criteria on the final rankings of the material alternatives. Dargi et al. (2014) developed a framework to support the supplier selection process in an Iranian automotive industry. They proposed Fuzzy Analytical Network Process (FANP) for weighting the seven measures which were found to be proper for the supplier selection process (Dargi et al, 2014).

3.1. Linguistic variables and fuzzy sets

A linguistic variable is a variable whose values are words or sentences in a natural or artificial language (Zadeh, 1975a). For instance, age is a linguistic variable if its values are assumed to be the fuzzy variables labeled 'not young', 'young', and 'very young' rather than the actual numbers. The concept of a linguistic variable provides a means for the approximate phenomena that are very complex or ill-defined to be amenable to the explanation in conventional quantitative terms. The main applications of the linguistic approach lie outside the realm of human systems, especially in the fields of artificial intelligence, human decision processes, linguistics, pattern recognition, psychology, law, medical diagnosis, data recovery, economics, and related areas (Zadeh, 1975b).

Fuzzy sets and fuzzy logic are powerful mathematical tools for modeling uncertain systems in industry. A fuzzy set is expanded to a crisp set. Crisp set allows only full membership or non-membership, whereas fuzzy sets allow partial membership. A fuzzy number $\widetilde{M}$ is a convex normalised fuzzy set of the real line R (Zimmermann, 1992).

- it exists, such that x ∈ R with $\mu_{\widetilde{M}}(x) = 1$;
- $\mu_{\widetilde{M}}(x)$ is piecewise continuous.

It is possible to use different fuzzy numbers depending upon the status. In applications, it is often convenient to work with triangular fuzzy numbers due to their computational simplicity, and because they are useful in promoting representation and information processing in a fuzzy environment. Triangular fuzzy numbers (TFNs) can be defined as a triplet (a, b, c), where parameters a, b, c orderly indicate the smallest possible value, the most promising value, and the largest possible value describing a fuzzy event. A triangular fuzzy number $\widetilde{M}$ is shown in Figure 1.

While there are various operations on triangular fuzzy numbers, only the important operations used in this study are shown. If we define two positive triangular fuzzy numbers (a1, b1, c1) and (a2, b2, c2), then

$$(a_1, b_1, c_1) + (a_2, b_2, c_2) = (a_1 + a_2, b_1 + b_2, c_1 + c_2)$$

$$(a_1, b_1, c_1) \times (a_2, b_2, c_2) = (a_1 \times a_2, b_1 \times b_2, c_1 \times c_2)$$

$$(a_1, b_1, c_1) \times k = (a_1 \times k, b_1 \times k, c_1 \times k), \quad \text{where } k > 0.$$

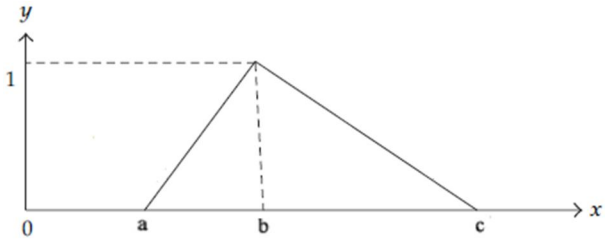

Fig. 1. A TFN $\widetilde{M}$

3.2. The Fuzzy Analytical Network Process (FANP)

The analytic network process (ANP) is a generalization of the analytic hierarchy process (AHP). The AHP was proposed by Saaty in 1980 as a method for solving socioeconomic decision-making problems and was used to solve a wide range of problems. The AHP is a framework of logic and problem-solving that spans the spectrum from instant awareness to fully integrated consciousness by organizing perceptions, feelings, judgments, and memories into a hierarchy of forces, which have influence on decision results. In the AHP approach, the system elements are assumed to be uncorrelated and uni-directionally influenced by a hierarchical relationship (Saaty, 2000).

The AHP approach is one of the MCDM approaches with extensive applications in a wide variety of areas such as selection, evaluation, planning and development, decision-making, forecasting, etc. (Hadi-Vencheh and Mohamadghasemi, 2011). The ANP approach is an extended version of the AHP approach that can be used to assess a dynamic multi-directional relationship between decision attributes (Saaty, 1988; Saaty and Takiawz, 1986). It has been defined as a non-linear network relationship among various factors. It allows for the capability to model more complex and dynamic environments, which are influenced by ever-changing external forces (Meade and Sarkis, 1998). The ANP approach is proposed to overcome the problem of interdependence and feedback between criteria or alternatives. The main difference between AHP and ANP is the ANP's capability of handling interrelationships between decision levels and attributes by obtaining the composite weights through the development of a super matrix (Saaty, 1996; Huang et al., 2005).

Most values of qualitative criteria are not clear, so it is not easy to make decisions with crisp numbers. Fuzzy numbers and linguistic variables support decision-makers to express the subjective judgments. Therefore, the fuzzy ANP approach is thought to be a more suitable approach to obtain realistic results. Some researchers have applied